PTO 08-1594

CC=JP
DATE=19761105
KIND=Kokai
PN=51127181

LIGHT-SELECTIVE TRANSMITTING FILM
[Hikari Sentaku Tokasei Fuirumu]

Hiroshi Sato et al.

UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. DECEMBER 2007
TRANSLATED BY Schreiber Translations, Inc.

PUBLICATION COUNTRY	(10):	Japan
DOCUMENT NUMBER	(11):	51127181
DOCUMENT KIND	(12):	Kokai
PUBLICATION DATE	(43):	19761105
APPLICATION NUMBER	(21):	50051719
APPLICATION DATE	(22):	19750428
INTERNATIONAL CLASSIFICATION	(51):	B 32 B 15/08, A 01 G 13/02
PRIORITY COUNTRY	(33):	
PRIORITY NUMBER	(31):	
PRIORITY DATE	(32):	
INVENTOR(S)	(72):	Hiroshi Sato et al.
APPLICANT(S)	(71):	Mitsubishi Rayon Co., Ltd.
DESIGNATED CONTRACTING STATES	(81):	
TITLE	(54):	LIGHT-SELECTIVE TRANSMITTING FILM
FOREIGN TITLE	[54A]:	Hikari Sentaku Tokasei Fuirumu

/1[1]

Specification

1. Title of the invention

Light-Selective Transmitting Film

2. Claim

A light-selective transmitting film, characterized by the fact that a thin metal oxide film layer that transmits at least 30% of lights with a wavelength of 0.4-0.7 μ and reflects at least 20% of lights with a wavelength of 2-10 μ is installed on at least one surface of a copolymer film being obtained by copolymerizing 26-77 wt% alkyl ester methacrylate in which the number of carbon atom in an alkyl group is 1-4 pieces, 3-74 wt% alkyl ester acrylate in which the number of carbon atom in an alkyl group is 1-8 pieces, and 0-40 wt% other monomers copolymerizable with them.

3. Detailed explanation of the invention

The present invention pertains to a light-selective transmitting film. More specifically, the present invention pertains to a light-selective transmitting film

[1] Numbers in the margin indicate pagination in the foreign text.

that uses a polyalkyl methacyrlate group copolymer film as a base material film, transmits 30% or more of visible lights with a wavelength of 0.4-0.7 μ, and reflects 20% or more of infrared rays with a wavelength of 2-10 μ.

After a light-selective transmitting substance is mixed with polyvinyl chloride resin, polyethylene resin, etc., and molded into a film shape or a light-selective transmitting substance is spread on the surface of these resin films, it is utilized as a light-selective transmitting film in many fields starting with the agriculture. For example, a selective transmitting substance of a visible part of lights is mixed with a polyvinyl chloride resin and molded into a film shape, and the utilization of this film is attempted as a film for agricultural houses that transmit only lights with a wavelength suitable for the growth of plants and accelerates the growth of the plants by cutting lights in other wavelength regions. Also, a film in which a substance having a selective absorption is mixed or spread on an ultraviolet part is attached to the surface of a resin molded product that is easily degraded by ultraviolet rays and used as an ultraviolet cut-off film for the improvement of the weather resistance of the resin molded product. However, since the light-selective /2

transmitting films prepared by any of the methods developed up to now are deficient in its durability, the weather resistance of the films is extremely lowered during the outdoor usage over a long term, and the functions cannot be sufficiently exerted, though the effects can be exerted to some degree by the characteristics of the selective light-absorbing substances at the initial stage in the above-mentioned various usages.

Accordingly, these inventors considered this current situation and reviewed the above problems to prepare a light-selective transmitting film without the above-mentioned drawbacks. As a result, it was discovered that a light-selective transmitting film that could achieve the above-mentioned purpose could be obtained by using a polyalkyl methacrylate group copolymer film at a specific composition ratio as a base material film and installing a thin film layer of a metal oxide with a light-selective transmission at each wavelength on at leas one surface of the film. Then, the present invention was completed.

The essence of the present invention is a light-selective transmitting film characterized by the fact that a thin metal oxide film layer that transmits at least 30% of lights with a wavelength of 0.4-0.7 μ and reflects at least 20% of lights with a wavelength of 2-10 μ is

installed on at least one surface of a copolymer film being obtained by copolymerizing 26-77 wt% alkyl ester methacrylate in which the number of carbon atom in an alkyl group is 1-4 pieces, 3-74 wt% alkyl ester acrylate in which the number of carbon atom in an alkyl group is 1-8 pieces, and 0-40 wt% other monomers copolymerizable with them.

The base material film being used in the present invention is a polyalkyl methacrylate group copolymer film with good transmission and weather resistance to visible lights being obtained by molding random copolymer, graft copolymer, block copolymer, etc., which are obtained by copolymerizing 26-77 wt% alkyl ester methacrylate in which the number of carbon atom in an alkyl group is 1-4 pieces, 3-74 wt% alkyl ester acrylate in which the number of carbon atom in an alkyl group is 1-8 pieces, and 0-40 wt% other monomers copolymerizable with them, by an ordinary molding method such as T die method, inflation method, and pressurized molding method.

As other monomers copolymerizable with the alkyl ester methacrylate and the alkyl ester acrylate of the copolymer constituting the base material film being used in the present invention, methacrylic acid, dialkyl ester of itaconic acid, acrylonitrile, methacrylonitrile, vinylidene chloride, vinyl chloride, styrene, ortho-, meta-, and para-

methylstyrene, α-methylstyrene, etc., are appropriately used.

The constitution and structure of the above-mentioned copolymer can be variously changed by the properties required for the base material film. Also, the adhesion of the base material film and the thin metal oxide film layer and the weather resistance of the base material film as the characteristics of the present invention are ascribed to the properties of the monomers in manufacturing the above-mentioned copolymer and do not depend on the ratio of each monomer in the range of the above-mentioned copolymer range. However, if the ratio of the alkyl ester acrylate of the copolymer is less than 3 wt%, the film being obtained becomes brittle, and a problem is caused in molding, so that the film cannot be practically provided. Also, if the ratio of the alkyl ester acrylate is more than 74 wt%, the film becomes mild and weak, and the mechanical strength is lowered. Furthermore, if the ratio of the alkyl acrylate ester in the copolymer is out of the above-mentioned range, especially the adhesion of the base material film and the thin metal oxide film layer is extremely lowered, so that a good light-selective transmitting film cannot be obtained.

In the present invention, as the thin film material of the metal oxide having a light-selective transmission being installed on at least one surface of the base material film, metal oxides such as copper oxide, indium oxide, cadmium oxide, and antimony oxide or these metal oxides containing an infinitesimal amount of dopant are used.

In applying the present invention, as the method for forming a thin film of a metal oxide having a light-selective transmission on at least one surface of the base material film, a method that forms a metal vapor-deposited thin film by vapor-depositing a metal capable of being an oxide in advance on one surface of the film under vacuum by /3 an ordinary method and oxidizes it in an oxidizing atmosphere, or a method that forms a metal vapor-deposited thin film and applies an anodic oxidation to it in an appropriate solvent so that the anodic oxidation is advanced, or a method that forms various kinds of thin metal oxide films by sputtering in a rare gas containing oxygen using tin, indium, cadmium, etc., as a cathode metal, etc., can be appropriately employed. Also, a metal oxide is dissolved or dispersed in an appropriate solvent and spread on a film, so that a thin film can be obtained. Furthermore, it is posttreated to be able to obtain desired characteristics. Also, the formation of these thin metal

oxide films is not limited to one surface of the film but can also be formed on its both surfaces, and if desired, thin film layers of the same kind or different kinds of metal oxides may be formed on both surfaces of the film.

In the present invention, the polyacryl methacrylate group copolymer film being used as a base material film has very good adhesion with the thin metal oxide film by the effect of its composition and can be prepared as an excellent light-selective film without any pretreatment. However, the adhesion of the base material film and the thin metal oxide film can also be further improved by further applying an oxidation treatment and an anchor coating treatment to the base material film surface.

Since the light-selective transmitting film of the present invention is a film mainly composed of a polyalkyl methacrylate group copolymer, the transmission to visible lights is good, and the weather resistance is excellent. Thus, even if the film is used at the outdoors over a long term, the optical degradation of the base material film is not caused, and the thin metal oxide film layer installed on at least its one surface can hold its characteristics over a long term.

The light-selective transmitting film of the present invention can be used in various usages by utilizing its

characteristics, and for example, in case this film is used as a greenhouse film for agriculture so that the thin metal oxide film layer is set as the inner surface, it almost transmits solar beams and can prevent the heat radiation from the inside, so that the growth of plants can be accelerated. Also, in case this film is used as selective transmitting film in a condensing system, it almost transmits solar beams and can prevent the heat radiation from the inside similarly to the above-mentioned greenhouse film for agriculture, so that the solar heat can be effectively prevented. Furthermore, this film can also be used as a cover for a solar beam hot-water supply system.

Next, the present invention is explained by an application example, all the parts in the application example mean parts by weight.

Application Example 1

A mixture of 90 parts butyl acrylate, 10 parts methyl methacrylate, 3 parts Berex OTP (sulfosuccinate group emulsifier made by Kao Atlas Ltd.), and 0.5 part triallyl cyanurate was sufficiently substituted by nitrogen and continuously added for 2 h into 200 parts aqueous solution containing 0.15 part $(NH_4)_2S_2O_6$ held at 70°C. After finishing the addition, the reaction was continued for about 30 sec, so that a latex of a polymer component (A)

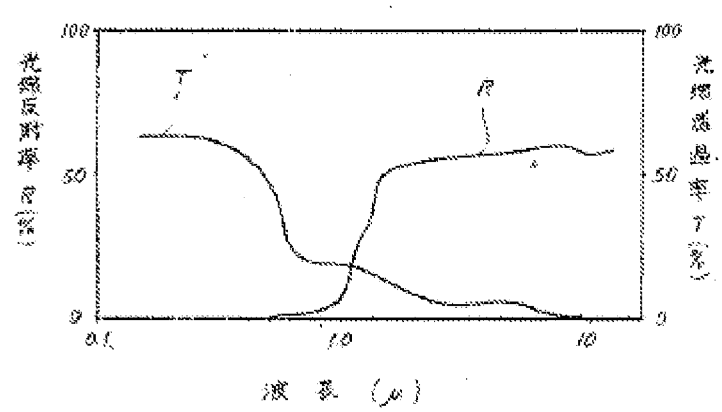
with a polymerization rate of 97% or more was obtained. 600 parts deionized water sufficiently substituted by nitrogen was added to the latex of the polymer component (A), the temperature of the reaction system was maintained at 85°C, and 0.30 part (dissolved in 10 parts water) Longarit (sodium formaldehyde sulfoxylate made by Wako Pure Chemical Industries, Ltd.) was added to the reaction system. Then, a mixed solution of 0.60 part Backmill P (trade name of diisopropylbenzene hydroperoxide made by Nippon Oil and Fats Co., Ltd.), 40 parts butyl acrylate, and 60 parts methyl methacrylate was slowly added for 1 h. After finishing the addition, stirring of the reaction system was continued for 30 min, and 0.2 part (dissolved in 10 parts water) Longarit was added to the reaction system. A mixed solution of 0.80 part Backmill P, 10 parts butyl acrylate, 190 parts methyl methacrylate, and 0.40 part octylmercaptan was slowly added for 2 h while maintaining the reaction system at 85°C. After finishing the addition of the mixed solution, the reaction was continued at 85°C for 1 h, and the polymerization reaction was substantially completed. The latex obtained was salted out by an ordinary method, and the polymer product generated was filtered and washed, sufficiently dried, and pelletized by an extruder. The pellet obtained was molded into a film

with a thickness of 75 μ by an inflation method. The total light transmittance of this film was 92%. This film was cut into 50 mm x 50 mm, and a metal tin (containing 1% /4 antimony) was vapor-deposited at a degree of vacuum of 5 x 10^{-5} mmHG under vacuum by a JEE4C type vacuum deposition apparatus made by JEOL Ltd, so that a vapor-deposited film with an average vapor-deposited film thickness of 90 Å was obtained. Using this vapor-deposited film as an anode, an electrolytic oxidation was carried out at 50°C and a current density of 2A/dm^2 in a mixed solution in which 1 L 10% aqueous soda phosphate solution and 20 mL phosphoric acid were mixed, so that a thin tin oxide film was obtained.

The light reflectance and the light transmittance at each wavelength in the film having a thin tin oxide layer obtained in this manner were measured, and the results are shown in the figure. In the figure, curve R shows the light reflectance, and curve T shows the light transmittance.

4. Brief description of the figure

The figure is a characteristic diagram showing the light reflectance and the light transmittance at each wavelength of an application example of the present invention.



1. Light reflectance R (%)

2. Light transmittance T (%)

3. Wavelength (μ)